DOCUMENT RESUME

ED 331 685 RC 018 152

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TITLE SMILE--Science and Mathematics Investigative Learning Experiences.
PUB DATE 90
NOTE 9p.; Paper presented at the Joint Symposium of the American Council on Rural Special Education and the National Rural and Small School Consortium (Tucson, AZ, March 18-23, 1990).
PUB TYPE Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *American Indians; Career Awareness; *College School Cooperation; Disadvantaged Youth; Engineering; *Enrichment Activities; Financial Support; *Hispanic Americans; Intermediate Grades; Junior High Schools; *Mathematics Instruction; Middle Schools; Rural Schools; *Science Instruction
IDENTIFIERS Native Americans; Oregon; *Oregon State University

ABSTRACT

Oregon State University (OSU) designed and implemented the Science and Mathematics Investigative Learning Experiences Program (SMILE) to encourage minority students to pursue careers in science and engineering. SMILE offers an after-school enrichment program for middle-school Hispanic and Native American students in eight rural Oregon communities. Each group consists of approximately 20 students who are working at or above grade level. Students engage in the following activities: (1) projects involving math, science, and computers; (2) monthly visits to sites of scientific interest near their school; and (3) the Challenge Weekend on the OSU campus in the spring. Teachers who lead SMILE groups attend workshops given by OSU resource faculty to help them plan group activities and enhance their skills in motivating and teaching their students. One SMILE group researched the process of recycling paper and made their own recycled paper. Another group studied the water quality in a nearby stream. Although funding the program has required much time and effort on the part of OSU faculty, current funding comes from corporate foundations and a community foundation. Despite the success of the program, charges of reverse racism have surfaced, and regular attendance has proved difficult for many students. Future plans include expanding the program to elementary schools, high schools, and additional communities and raising funds for scholarships. (KS)

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SMILE - Science and Mathematics Investigative Learning Experiences

Outline of the Program

"...SMILE is helping me do better in school, and I'm seriously considering going to college." These words from a SMILE student confirm that the SMILE Program is helping to change the attitudes and raise the expectations of the participants. Middle school minority students from rural communities are being introduced to the wonder and excitement of science and mathematics and an awareness of these disciplines in the world around them. They're discovering career options other than the entry-level jobs they may be familiar with, and being encouraged to aspire to these careers through sound educational preparation and hard work.

SMILE is an enrichment program for middle school minority students in eight rural Oregon communities. SMILE groups, consisting of approximately twenty students, meet weekly outside of school hours with specially selected teachers. They work on projects involving math, science and computers. About once a month they visit a site of scientific interest near their school. All the groups visit the Oregon State University (OSU) campus in the spring for a Challenge Weekend of activities involving OSU faculty and role-model university students. Interested minority students who are working at or above their grade level, and are recommended by a teacher, can apply to join the SMILE club in their school.

The teachers who lead SMILE groups attend workshops given by OSU Resource Faculty to help them plan group activities and enhance their skills in motivating and teaching their students. Current materials and methods are presented, along with suggestions for integrating math, science, and computer concepts in classroom activities. Four workshops, totaling ten days, are planned for the academic year.

Background

Oregon State University has made a firm, forward-looking commitment to widen access to higher education for minority and disadvantaged students. In its 1987 long-range plan, "Preparing for the Future", this commitment is strongly stated. Numerous programs and initiatives which directly

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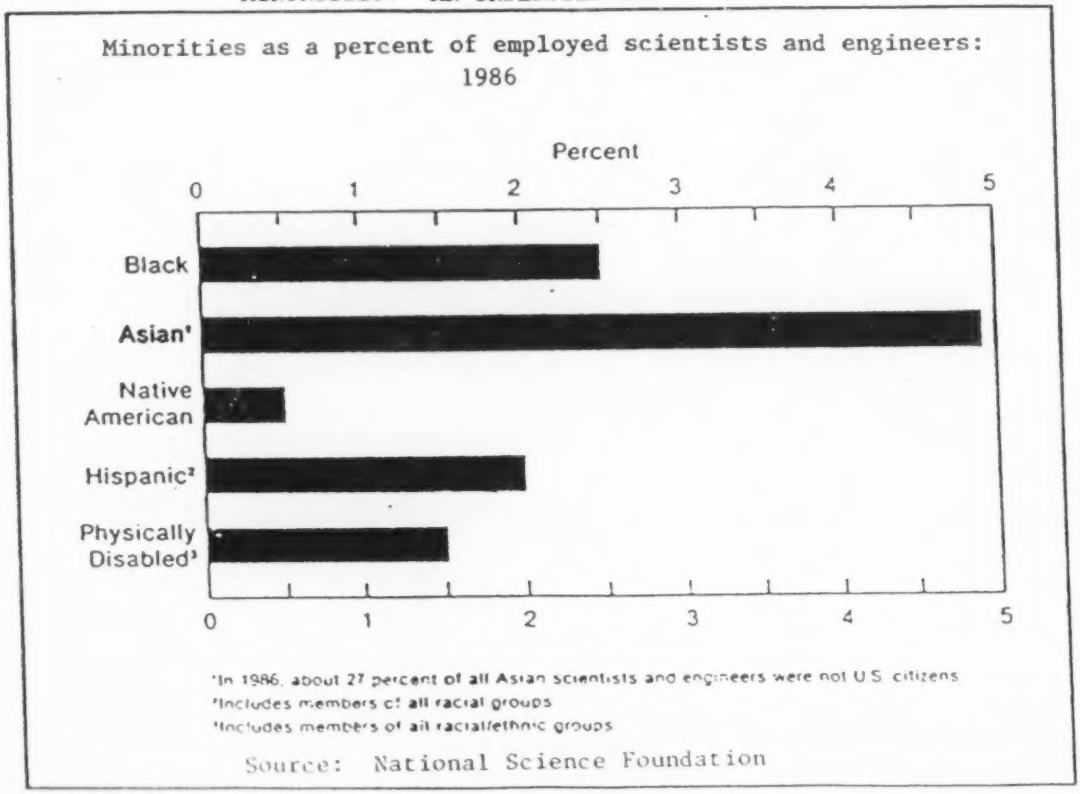
contribute to this end for the minority and disadvantaged students enrolled in the university are operating at Oregon State. We recognize, however, that much greater effort is required at lower educational levels if students are ever to reach high school, graduate, and attempt to enter and succeed at a post-secondary institution.

A great deal of attention has been given recently to the projected shortfall in the supply of scientists and engineers required to meet the nation's academic and research needs by the turn of the century. The National Science Foundation reports that of the approximately four million tenth grade students in 1977, only 9,700 are expected to attain a Ph.D. degree in either science or engineering by 1992. According to NSF the number of graduate scientists and engineers needed in the U.S. between 1989 and 2010 is over 700,000 if we are to be competitive with other technological nations. Clearly, we face an imminent national crisis which must be addressed by all sectors of society. The SMILE program focuses the interests of the community, the school system, the family, and industry at an immediate local level on this national crisis.

To close this gap our society cannot afford to ignore the resources represented by the potential of a large portion of our population. Although by the year 2000, approximately 30% of the total college age population will be minorities, the percentages of Blacks, Hispanics, and Native Americans receiving higher degrees in technical fields will still be in the 2-3% range. In fact, no United States minority groups participate in secondary, post- secondary or graduate education in proportion to their representation in the population. Neither are they represented in the workforce as professional scientists or engineers. (See figure below).

MINORITIES: AN UNDERUSED RESOURCE



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Genesis of the SMILE Program

Faculty in research oriented universities often find a lack of staff support and interest in seeking funds for special programs to serve non-traditional students. Until very recently, pre-college programs were entirely ignored on many college campuses. SMILE began in a conversation between two women with similar interests and experience in academic programs for non-traditional students. One, a staffer in the university development office was aware of many potential funding sources. The other was administratively in a position to move the university in the direction in which she thought it should go. Together, they approached the dean expected to be most sympathetic to the SMILE concept. The dean was not only sympathetic, he was enthusiastic and convened a brainstorming session to determine the extent of interest within his college, the College of Science. Two years into the program, the response of the science faculty at Oregon State continues to highly enthusiastic about the program. Science faculty volunteer to design presentations about th field and research so that the middle school teachers can adapt the material for their own stud..ts. Faculty offer to travel to the participating schools and lead students and teachers on Discovery Tours related to their specific discipline.

The ripple effect from the enthusiasm in the College of Science has spread to the Colleges of Engineering and Education. All three deans now serve on the SMILE Advisory Board. The College of Engineering, through the Challenge Weekend activity, is becoming increasingly involved in the year-round SMILE activities. In addition, the Colleges of Veterinary Medicine and Forestry have participated in the teacher's curriculum workshops. It is clear that OSU's colleges have heard and believe the message about the rapidly shrinking supply of technically trained people for our nation's work force.

Geographic and Demographic Impacts on the SMILE Program

The thirteen western United States (with the exception of California) are similar in many ways that affect the organization of the SMILE program. The states are generally large in size with diverse terrain, have only one or two major urban areas, have small, widely scattered communities with resulting small school districts, tend to be heavily dependent on the extraction of natural resources and are among the less affluent states. In Oregon, the main geographical constraints concern travel during inclement weather and the great distances, over mountains, between OSU and seven of the eight SMILE school districts. The closest SMILE group is located 55 miles from Oregon State University; the farthest is located 400 miles distant, near the Idaho border. All the SMILE groups (except the closest one) must contend with mountainous terrain and winter snow and ice in order to reach the OSU campus. The three groups most distant from OSU must allow an extra day of travel to reach OSU for a scheduled activity.

The cumulative effect of these conditions is that teachers and students in many communities in the state experience real (or perceived) isolation, teach and learn in inadequately equipped schools, lack opportunities for stimulating experiential learning, and suffer from severely restricted personal and career aspirations. Information derived from the 1980 U.S. Census shows that 39% of the children attending small, rural schools come from families experiencing chronic poverty. If students in these communities are also members of a minority group and poor, the disadvantages of their condition are greatly compounded.

Oregon State University takes very seriously its role as a Land Grant institution. Our efforts to enhance the educational experiences of minority students through outreach programs is clear evidence of this commitment. Since Oregon has the second highest number of small schools among the thirteen western states, the University elected to focus its efforts on eight rural Oregon communities which are small, geographically isolated, poor, and which have significant minority and disadvantaged populations. None of the eight participating communities is sufficiently large or affluent enough to support a science museum, zoo, or comprehensive library system which can augment the educational experiences of students in its public school system. Further, the school districts in question generally do not include enough commercial or industrial establishments in the tax base to provide an adequate educational budget for the districts' schools. Although the Oregon State Legislature has created the "School Safety Net" for districts in financial difficulty, this mechanism merely ensures that the schools will be able to operate at the level of the previous year's budget. When inflation is taken into account, a Safety Net district must of necessity cut its school budget. Several SMILE school districts have recently fallen into or are presently in the School Safety Net.

Finally, the minority residents of these eight communities tend to be "invisible" in civic life. Minority role models are simply not represented to any significant degree in the political and commercial life of these eight communities. Mayors, policemen, newspaper editors or reporters, principals, coaches, etc. are conspicuous by their absence. Five communities include major Indian populations; three communities include many Hispanic/Mexican American residents who have settled out of the western stream of migrant workers.

A major characteristic which rural Hispanic and Native American Oregonians share with their urban cousins is a history of limited opportunity and expectations. In the Portland area, efforts are underway to mitigate the historical effects of disadvantaged status and to capitalize on the existence of museums, the zoo, and a comprehensive library system. Only a few isolated efforts of this kind presently exist in rural Oregon communities and only one of these is specifically aimed at a specific minority community.

The decision, in 1988, to begin the SMILE program in the middle grades was made deliberately. The greatest dropout of minority and disadvantaged students from the public schools occurs just before and during the ninth grade. We realized that if we hoped to capture the interest of minority students for science and mathematics we had to reach them while they were still in school and still at an impressionable age.

The SMILE Program and its Goals

The current middle school SMILE program is fully functioning in eight rural communities. The program provides exciting mathematics and science enrichment activities, strong academic encouragement and career motivation and information to 160 Hispanic and Native American students in the sixth, seventh, and eighth grades. Each group of 20 students meets weekly after school with their teacher for enrichment activities, takes local area field trips every month and participates in specially developed engineering activities during a Challenge Weekend on the Oregon State University campus in the Spring. At Oregon State University, the students work in small groups with OSU faculty from various science and engineering departments. Throughout the Challenge Weekend, Hispanic and Indian university students act as guides and role models for the young students.

Regardless of age level, academic intervention programs for disadvantaged students tend to have generally similar goals. Specifically, SMILE program goals are the following:

1. Encourage development of skills, attitudes and self-confidence necessary to succeed in school
2. Provide a variety of enrichment activities which reinforce skills and attitudes needed for success in engineering, mathematics, and science based careers
3. Provide opportunities for students to interact closely with a variety of persons working in scientific/technical occupations
4. Inform students and their parents of career options open to students ready to undertake the challenges presented by the scientific disciplines
5. Enlist parents as active participants in the after school activities, monthly trips and college visits so that they support their children's continuing educational opportunities.

The SMILE program, begun in 1988 with only four school districts participating, was increased to eight school districts in the present 1989-90 academic year. In addition to the activities for the students, sixteen mathematics and science teachers who are the SMILE group leaders attend ten days of curriculum development workshops led by OSU faculty from diverse academic disciplines. These workshops help to mitigate some of the adverse conditions which affect teachers in small, rural school districts.

The teachers who implement the SMILE program are clearly a major factor in the success or failure of the program. Our goals for teachers in the SMILE program are to:

1. Facilitate development of skills in conveying math/science subject matter to the targeted students

2. Enable the participants to become role-models for their colleagues, inspiring and assisting them in using new methods and materials in their classes.

The mechanism adopted to help teachers achieve the above goals is a series of curriculum workshops held at Oregon State University. In these workshops, OSU faculty present current materials appropriate for middle school students and give teachers hands-on experience in using them. They conduct tours of science and math facilities and suggest ideas for projects and discovery tours in the groups' local areas. For example, during the Fall workshop, the education specialist in the College of Forestry presented materials from Project Learning Tree, the National Wildlife Federation, and others for use with middle school students. The teachers spent an afternoon in the OSU McDonald Forest mapping the area, taking core samples of trees, estimating tree height and determining percolation rates of soil samples.

The key to the success of SMILE program activities lies in the emphasis placed upon integrating mathematics and communication skills into every science activity the students undertake. We believe that if students come to see how mathematics can be used to understand and explain science concepts, they will have a better idea of the uses of science and how it affects them, their families, their community and the larger groups of which they are part. Several examples of activities being used by SMILE groups will illustrate how SMILE teachers are helping students to integrate communication, mathematics and science skills.

Several SMILE groups have established recycling programs in their schools. One group collected data on the amount of paper discarded in their school and determined how they could reduce that

amount through their efforts in recycling. They researched the process by which paper is made and then made their own recycled paper. The paper was used to make posters advertising their project. They subsequently presented their findings about the amount of paper that could be recovered in one school to school officials, the school board, and their fellow students, thus reinforcing their communication skills. Later, they visited recycling centers in nearby communities to see first hand how the recyclable materials are processed and what use is made of them.

A group located in a Native American community chose to study water quality in a stream that flows through the town. With the help of tribal biologists, students sampled water at various locations and examined the contents of those samples in various ways. They learned about an endangered species of fish that lives in the stream and hope to help preserve that species through their study of its environment. They interviewed people in the community about their opinions and perceptions of the quality of the water over a period of several years and reported their findings to the group. To gain some perspective and background on the problem, they visited a local fish hatchery and the nearby High Desert Museum.

Another Native American group is participating in the Steelhead-Trout Enhancement Program (STEP) by raising steelhead eggs in an aquarium and obtaining permission from tribal authorities to concentrate their studies on a creek that flows through the reservation. In obtaining this permission, students learned several tribal stories connected with the site and are preserving these stories, using their computer word-processing skills.

The Joys and Sorrows of Funding

Three years ago a major corporation approached the university with the suggestion that we submit a proposal for a major program of minority student support. A proposal was submitted and subsequently rejected by the corporation. Our initial disappointment quickly turned to anger and then to the determination to seek many sponsors rather than depending on one or two benefactors. Funding for the present SMILE program comes from corporate foundations, and a community foundation. The Challenge Weekend is funded by the U.S. Department of Energy Pre-Engineering Program (PREP). The ten days of teacher curriculum workshops are supported by the Eisenhower Mathematics and Science Education Act, Title II, of the U.S. Department of Education. Representatives of many corporate sponsors also participate as members of the SMILE Advisory Board whose function is to assist the university in guiding and evaluating the program.

Once the decision to create the SMILE program had been made, the task of raising the funds necessary to support the program became paramount. The university was not in a position to fund an experimental program at the middle school level with hard money. The school districts, as noted above, were uniformly under funded and were all operating on "no frills" budgets. Thus, it was decided, both for pedagogical as well as strategic reasons, to involve as many corporations as possible as sponsors. A basic tenet of the program's creators was that the program should be able to operate in each school without financial obligation to the school district. We did not want to give any district the opportunity to reject the program by pleading poverty. All that was asked of each district was administrative cooperation and sanction for the program, and space and time for the groups to meet.

Raising funds for the initial four SMILE groups consumed about eighteen months and required us to begin the program a whole year after our expected start time. Fortunately, the program took off

like a rocket and there was immediate grass-roots demand to include more communities in SMILE. Renewed fund raising efforts began for an expanded program to begin the following Fall. By late summer of 1989 only half the funds needed for the expanded program had been pledged or received. The dilemma was whether to begin the new year with the four "old" programs and start the new programs when we had secure funding, or to start all eight programs together and assume that the remaining funding would materialize. We decided on the latter course of action, and the necessary funding has been received. We are now thoroughly conversant with the "lead time" required for corporate foundations to process funding applications.

A problem arose which should have been anticipated regarding the stipend awarded to each SMILE teacher. Each teacher received the usual amount paid for conducting an after-school activity. We did not foresee that someone would have to pay the Public Employees Retirement System (PERS) contribution for each teacher. The teacher stipends, including PERS contributions for regular after-school activities such as clubs or coaching are budgeted routinely by school districts; SMILE activities are funded from outside and thus the PERS had not been budgeted for by the district. Most of the teachers lost almost a third of their stipend to cover the PERS assessment.

This situation led to a change both in philosophy and procedure. Initial planning of SMILE included the goal of institutionalizing the program within each locally controlled school district. Before an impoverished school district would consider adding a new academic program to its budget, a solid record of success would have to be demonstrated. However, since we wanted SMILE to be regarded as a "regular" academic activity worth at least as much as coaching a sports activity or the rally squad, we came to regard the PERS issue as important to the credibility of the entire program. Shortly after the programs began in Fall 1989, each district superintendent received a letter listing the benefits of the program for the district's students and calling attention to the issue of the PERS payment. A request was made for the district to cover the PERS for their teacher. Although not one superintendent replied to the letter, several districts did cover the cost of the PERS. The strategy for the third year of the program will be to include the cost of the PERS for the teachers whose districts did not cover the payment in the SMILE budget and to inform those district superintendents that the university would make the payment for the year and thus provide them time to include the PERS cost in the budget for the following year.

Problems, Problems

Despite the description of SMILE as having taken off like a rocket, the program has encountered its share of difficulties and problems. Charges of reverse racism have surfaced in several of the communities. Questions have been raised as to why these special academic opportunities have been provided to a small group of minority students while "other" students are denied the opportunities. One middle school was so incensed about this "inequity" that it reestablished its middle school science club which had been allowed to fall into inactivity. Now, the school has two science clubs whose leaders cooperate with each other and whose students frequently undertake joint projects. We regard the result as a net gain for students although the underlying problem of latent racism has not been mitigated in any way.

Many of the ordinary problems that plague any extra-curricular school activity are evident in SMILE as well. SMILE students are generally members of low-income families. Although students and their parents sign an agreement that includes a commitment to regular attendance at SMILE meetings,

students are frequently pressed into service as family baby-sitters so parents can work. Other work related responsibilities interfere with student's participation in SMILE trips or meetings. Surprisingly, team sports have not proved to be as big a problem as was anticipated. School coaches have been cooperative about letting SMILE students leave practice sessions early or even miss a practice to go on a SMILE trip. This rather relaxed attitude on the part of the coaches may be related to the fact that the students are middle school rather than high school athletes where team sports have traditionally been the preeminent extra-curricular activity.

California gangs have been systematically entering Oregon and SMILE students, as other students, are experiencing pressure to join. "You don't want to be a 'schoolboy', do you?" is a hard question for minority students to deal with.

Future Plans

From the very beginning, the SMILE program was envisioned as a three-level "educational pathway" leading minority students from elementary school, through middle and high school into post secondary education. As they progressed along the pathway, students would be helped to continually reinforce and expand upon the academic skills learned in their regular academic programs, become intrigued by and excited about science, be informed about science and math-based careers, and, along with their families, made aware of the financial aid and scholarship opportunities which exist for higher education. Oregon State University intends to extend the SMILE program in the near future to the elementary and high schools in these eight rural school districts. Once the program is securely established in the three academic levels, additional communities may be added to the SMILE program.

Probably the biggest barrier to the entrance of Oregon minority students into higher education is the financial barrier. Three years ago, the Oregon State System of Higher Education established a Minority Scholars program consisting of four-year scholarships to a state supported institution. Enrollment of Blacks, Hispanics and Native Americans increased significantly at all state schools. Many of the minority scholars had <u>not</u> previously applied to any college or post-secondary school until the scholarship opportunity became available. Thus, the next major enhancement for the SMILE program will be a fund-raising campaign to generate scholarship guarantees for eighth grade SMILE students who take science and mathematics courses <u>every</u> year of high school and meet the entrance requirements to any public college or university in Oregon.

Summary

Many of the programmatic components of the SMILE middle school program through Oregon State University are not unique. The need for such programs for minority students has been frequently documented and similar science/mathematics enrichment activities have been used throughout the country. What we believe <u>is</u> unique in SMILE is the attempt to bring the educational advantages of the urban environment and the university to minority students in isolated rural areas and the linking of a professional development opportunity for the teachers involved in the program. SMILE tries to compensate for the major educational disadvantages of rural minority students and their teachers.